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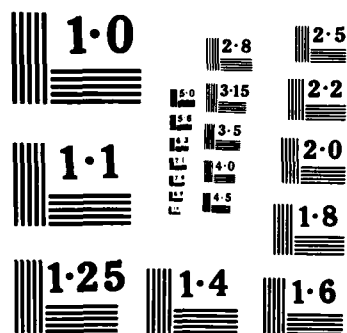
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NEUROPSYCHOLOGICAL EFFECTS OF  
LONG TERM LOW DOSE MERCURY  
EXPOSURE IN DENTISTS

By

JAMES CHARLES CASSELL JR., BSN

PROJECT

Presented to the Faculty of The University of Texas  
Health Science Center at Houston  
School of Public Health  
in Partial Fulfillment  
of the Requirements  
for the Degree of

MASTER OF PUBLIC HEALTH

THE UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER AT HOUSTON  
SCHOOL OF PUBLIC HEALTH  
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June 1985

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Finally I would like to express special thanks to my wife without whose support none of this would have been possible.

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### VITA

James Charles Cassell, Jr. was born in Pensacola, Florida. on October 16, 1952, the son of James Charles Cassell and Anna Laurie Cassell. After completing work at Fremont High School, Fremont, Nebraska in 1971 he entered the US Army. Following completion of his tour of duty with the US Army in 1973 he entered the University of Nebraska at Lincoln. In 1974 he transferred to the University of Nebraska Medical Center College of Nursing. He received an Associate of Science in Nursing in 1976 and the degree of Bachelor of Science in Nursing in 1978. He was married to Diane Lynn Dixon of Hastings, Nebraska in January of 1977. In June of 1978 he entered the United States Air Force Nurse Corps as a second Lieutenant. He has attended several service schools to include Flight Nurse training, Nursing Service Management, and Squadron Officers School. His most recent assignment was as a Flight Nurse in the Second Aeromedical Evacuation Squadron, Rhein Main, Germany where he was a flight clinical coordinator and instructor flight nurse. His daughter Elizabeth was born in 1978 and son David was born in 1982.

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## INTRODUCTION

The effects of exposure to high concentrations of mercury have been known for thousands of years. The toxic nature of mercury has been exploited by almost every civilization. For most of recorded history the health hazard associated high doses of mercury while known, has not prevented its' widespread and indiscriminant use. It has only been within the last century that nations of the world have placed strict guidelines on the use and disposal of mercury. Unfortunately, it has taken several major disasters with large numbers of casualties to generate interest in formulating guidelines and implementing them. It has only been within the last fifteen years that the United States (and most of the rest of the world) have adopted standards limiting occupational exposure to mercury.

These standards were created to protect the general population as well as workers occupationally exposed to mercury. The limits placed on occupational exposure while allowing higher exposure levels assume the worker will only be exposed for eight hours a day, five days a week and fifty weeks a year. The standards established for occupational exposure were set at levels below which symptoms of mercury poisoning should occur. These safe levels of exposure have been established based upon study of data from several natural experiments in which large populations were exposed to high levels of mercury.

There have been few studies of the effects of long term exposure to mercury in concentrations which do not cause acute poisoning. From the few studies conducted on the effects of long term low dose exposure to mercury several potential health hazards have been identified. The conditions attributable to long term exposure to mercury, at levels considered safe are: renal damage, hypertension, paresthesias and neuropsychiatric disorders. The development of one of these conditions in an older person, who has been occupationally exposed to mercury, is seldom associated with mercury exposure. The lack of a suspected association stems from a higher prevalence of these conditions in older individuals. The fact that these conditions are frequently seen in certain occupations is seldom attributed to anything but the aging process. To further confound any possible association the more severe of these conditions, renal damage and hypertension, can be treated easily and successfully without ever understanding or knowing the cause. While paresthesias are not as amenable to treatment, they do not appear to be considered a serious threat to health. On the other hand, neuropsychiatric disorders may not be amenable to effective treatment and may pose a serious threat to an individual's ability to perform his normal activities of daily living, including his profession.

One group of individuals occupationally exposed to mercury for long periods are dentists. The average dentist may be exposed to mercury on a daily basis for forty years (this assumes graduation at age 25 and retirement at age 65). Individuals practicing general dentistry are at greatest risk of exposure to mercury. If exposure to low doses of mercury over long periods of time does cause an increased prevalence of the neuropsychiatric disorders, xenophobia, erethism and depression, dentists as a group may demonstrate this increased prevalence.

If the assumption is true that low level mercury exposure is associated with an increased prevalence of neuropsychiatric disorders among dentists definite steps need to be taken to eliminate the exposure. There are a variety of steps that can be taken to decrease or eliminate mercury exposure. These steps include replacement of mercury amalgam restoration by other non-mercury alloys, use of resin compound restorations and many other planned but untried technologies. To give creditability to requests for a drastic change in the practice of dentistry it is necessary to obtain sound data indicating this change is necessary. An appropriate, valid and useful study, establishing a strong association between tissue mercury levels and the prevalence of neuropsychiatric disorders in dentists will provide the necessary creditability.

## LITERATURE REVIEW

A study conducted by Camerino et al. indicated that workers exposed to mercury at concentrations below the threshold limit value (TLV) for occupational exposure had losses in memory and efficiency (Camerino, 1981). The study further demonstrated increases in neurotic symptoms directly related to increasing urine mercury concentrations. This study, conducted in a mercury extraction plant in Italy, compared psychological differences between a cohort of workers occupationally exposed to various concentrations of mercury on a daily basis with workers not exposed to mercury at all. The researchers claim to be able to blindly identify those workers exposed to mercury based upon psychological testing alone. While the statistics used support the authors conclusions, the limited size of the exposed group (n=52) and comparison group (n=16) may be too small to generalize the findings. As stated by the authors this study does provide motivation and a basis for additional research.

In support of Camerino's findings is an extensive study by Bleecker who found that workers occupationally exposed to mercury had greater amounts of neurobehavioral and neurological impairments than workers not exposed (Bleecker, 1984). Articles by Ross, Feldman and Hanninen provide

literature support for the findings of these two studies (Ross, 1983)(Feldman, 1982)(Hanninen, 1982).

A 1974 study conducted by Buchwald indicated that individuals working in dental offices were at significant risk of exposure to mercury vapor (Buchwald, 1972). The average daily mercury vapor concentrations in the air of dental offices studied were generally below the safe occupational exposure TLV (.05 mgm. per cubic meter of air). However, vapor concentrations would greatly exceed the TLV periodically during the day. These periods corresponded to insertion or removal of dental amalgam tooth restorations. It was found that vapor concentrations quickly returned to safe levels once the procedures were completed. The study further demonstrated that some dental workers had urine mercury concentrations higher than would be expected based on the average vapor concentrations encountered. The study indicated several other sources of mercury vapor contamination in addition to amalgam. These other sources include carpeting, porous flooring material, and air conditioner filters.

A review of the literature indicates one in every seven dental offices has mercury vapor concentrations exceeding the safe TLV for mercury vapor exposure (Schneider, 1974). Reinforcing this figure is a study conducted by Harris et al. (Harris, 1978). Dr Harris and his co-workers studied 115 dental offices and found significant levels of mercury

contamination in many of them. Additionally, he found over 50 percent of the dentists and dental workers in these offices had elevated urine mercury levels. The elevated urine mercury levels were closely related to the method of handling the mercury used in amalgam preparation.

Shapiro et al. conducted a study on dentists to determine the relation between health and exposure to mercury (Shapiro, 1982). The study started with a sample of 298 dentists. The sample was broken down into subgroups based on the measured tissue burden of mercury. Dentists with mercury levels in the upper twenty percent of the sample were placed in one group. The control group consisted of age matched dentists with the lowest tissue burdens of mercury. A battery of psychological examinations were administered to the two groups. The findings of these examinations indicated a higher amount of neuropsychological impairment in the dentists with high tissue burdens of mercury. Specifically, dentists with high mercury levels had more visuographic alterations and higher psychological distress levels than dentists in the control group.

Mercury tissue burdens in dentists studied were measured in a previous study conducted by Shapiro and Bloch (Shapiro, 1981). In this study the reliability of a non-invasive method of determining mercury concentrations in body tissue was established.. Previous measurements of mercury intake relied on urine mercury levels and

### Resources Required

Space: One office for the storage of files and to provide work space will be needed full-time for the entire study.

People: A program director responsible for overall management and reporting of the study findings. The director will be needed for the entire study.

Clerk/Typist to prepare questionnaires, instructions and provide other clerical support as needed. Clerk/Typist will be needed full time for the planning and form construction phase and part time thereafter.

Clinical Psychologist to interpret SCL-90 tests and function as a consultant as need occurs. Needed as a part-time consultant for the entire study. More of the Psychologist's time will be needed as the tests begin to be returned until June of 1987.

Computer programmer to input study data and perform computer analysis on the data. Needed from June 1987 until all data is processed and analysis is completed.

Equipment: One desk, one typewriter, one file cabinet, one personal computer (with soft ware-- spread sheet, data base, graphics and statistical programs), printer and telephone with autovon capabilities. All equipment will be required for the entire study period.

## BUDGET

### Time and Facilities Required

The time table for the proposed study is as follows:

Jan- Apr 1986            Approval, planning and formal request for personnel and resources.

Apr-June 1986           Questionnaire and instruction sheets will be created and printed. Copies of the SCL-90 tests will be obtained. Questionnaire testing.

June 1986                Study packets will be sent to all USAF dentists.

June 86-June 1987       Study packets completed and returned by all dentists.

Jan- Sept 1987           SCL-90 are graded as they are returned.

April 1987               Follow up contact with the dentists who have not responded.

June-Sept 1987           Data inputed into the computer.

Sept-Nov 1987           Data is analyzed and the study findings reported through command channels to Air Force Surgeon General.



The total number of cases needed for the study is 133. The total number of controls needed is 399.

disorders in dentists. The null hypothesis of this study implies no association between mercury exposure and the neuropsychological disorders to be measured.

The information in table 1 is provided to permit comparison between the two groups. The two groups are expected to be similar in all areas except for SCL-90 composite scores.

Once the data is obtained and the odds ratio determined, the stability of the data will be established by use of a Chi square test. The Chi square test will provide an indication of the odds of obtaining the data by chance. In addition, the trends test for use on a table of two by any number will establish whether the trend that is expected could have happened by chance alone. The stability of the group mean comparisons (table 1) will be established by use of t tests on each of the comparison sets.

In order to increase the validity of the study calculation of the minimum sample size has been accomplished (Schlesselman, 1974). Given the following parameters:

Table 3

Population Parameters

PREVALENCE= .7  
RELATIVE RISK= 2  
TYPE I ERROR= .05  
TYPE II ERROR= .20  
MATCHING RATIO= 3

levels are available as single continuous values which relate directly to tissue body burdens. These values are also easy to input into a data base. Data in this form permits the formation of computer matrices by group and subgroup. These matrices will ease later analysis and retrieval of the data.

### Data Analysis

This study design will provide an estimation of the relative risk of developing neuropsychiatric disorders given exposure to mercury by use of an odds ratio. Information for computation of an odds ratio is found in table 2. The

Table 2  
Tissue Mercury Burdens in cases vs. comparisons

		Tissue mercury burdens			
		>0.2 mg	<0.2 mg >0.05 mg	<0.05 mg	
SCL-90	+	a	b	c	x
score	-	d	e	f	n-x
		q	r	s	n

following formula would be used to compute the odds ratio:

- 1)  $a \times e / d \times b = OR-1$
- 2)  $a \times f / d \times c = OR-2$
- 3)  $b \times f / e \times c = OR-3$

The relative risk estimate will provide the measure of association between mercury exposure and neuropsychiatric

All individuals in this study will be placed into one of two groups. The study group will contain only those dentists whose SCL-90 scores indicate they are suffering from either depression, erethism or xenophobia. The second group will contain the case comparison individuals with scores indicating no problems in the areas of interest. Each group will be divided into three categories based on the level of mercury exposure. The first category will include those dentists with tissue mercury levels above 0.2 milligrams per gram of body weight. The second category will be composed of dentists occupationally exposed to mercury by history, but who demonstrate mercury levels below 0.2 milligrams but equal to or above 0.05 milligrams per gram of tissue. The third category will be composed of individuals who have not been occupationally exposed to mercury and demonstrate tissue burdens of mercury below 0.05 milligrams per gram of tissue. Individual dentists not occupationally exposed to mercury by their history, but who demonstrate tissue mercury levels, will be placed into category one or two based on their tissue mercury levels.

The SCL-90 provides single continuous numerical values which ease computer input. The computer program, SCORE-90 permits scoring and correlation of data to provide information on the dimensions of interest. This correlated data, already in computer form, lends itself well to input into a data base. In addition, urine and blood mercury

questionnaire to one central facility for evaluation and analysis. In addition, a cover letter would be sent to all USAF medical facilities requesting the Commanders' support and stating the purpose of the study including the confidential nature of the individual's tests scores (Appendix A).

The SCL-90 compares favorably with the MMPI tests (long considered the standard of measurement for psychological exams)(Derogatis, 1976). The SCL-90 has been validated in several other studies and provides some specificity to the type of individual in this study. The test has been used in several studies of individuals who are educated with a strong scientific background, and who are in the middle to higher social category.

As stated, each study packet will be accompanied by a statement of purpose and confidentiality (Appendix B). This statement will be written in accordance with current Air Force regulations. Participation in this study will be strictly voluntary with no penalty for refusing to participate. All information obtained will be coded and reported only as group data and interpretations. The individual's name will be removed from all tests prior to test interpretation and data input. The individual's name will only be used to keep record of those who has respond regardless of their willingness to participate..

The SCL-90 is a self reported inventory and is designed to be taken by the individual based on written or verbal instructions. Scoring of the test can be done using a computer program called SCORE-90. While the actual scoring does not require any special training, interpretation of the results will require a psychologist trained to do these interpretations. Not only is it possible to measure individual areas, an assessment of the individual's overall symptom distress is possible by calculating aggregate scores.

Once validated, the background questionnaire can be answered based on printed instructions. The actual interpretation of the information is a simple matter of organizing it into categories. Urine and blood mercury tests require technicians specialized in obtaining them and performing the required chemical analysis. Again interpretation is done by organizing the values into preset categories.

Copies of the study packets to include: SCL-90 test packets, background questionnaire, privacy act statement, instructions and a statement of the study purpose will be sent to all USAF dentists. Detailed instructions on taking the SCL-90, obtaining the lab specimens and filling out the background questionnaire will accompany the study packet. Each dentist will be requested to send completed psychological tests, blood and urine mercury levels and

burden. Blood and urine mercury values provide a direct indication of this body burden and can be expressed as micrograms of mercury per gram of tissue. The tissue mercury value will be stated as the mean value of the absolute blood mercury value and the absolute urine mercury value or as the single absolute value if only one of these values are available (Gosselin, 1984)(Shapiro, 1981). The tissue mercury burden will then be expressed as milligrams of mercury per gram of tissue.

The dependent variables to be studied are neuropsychiatric disorders in dentists. The disorders of special interest in this study are depression, erethism, and xenophobia. The SCL-90 will be used to quantify these neuropsychiatric disorders in all subjects. The SCL-90 is a ninety item self reported multidimensional symptom inventory. While the test provides information on nine symptom dimensions, only five are of interest to this study. The five dimensions which provide a measure of the disorders of interest are: somatization, depression, anxiety, hostility and phobic anxiety. Specific items in the inventory relate directly to each dimension and provide a basis for scoring each area. The numerical score given to each symptom dimension provides the basis of determining if an individual has one of the disorders of interest. All individuals receiving a score above the cut off in any dimension will be placed in the case group.

For the purposes of this study, exposure will be implied by two methods. Measuring the mercury levels found in blood

Table 1  
Demographic Data

	SCL-90 score	
	+	-
Mean age		
age range		
males		
females		
length of service		
length of practice		
Hg level > 0.2 mg		
Hg level < 0.2 mg		
no. unexposed		
Marital status		
married		
unmarried		
widow		
divorced		
SCL-90 composit score range		
SCL-90 composit score mean		

and urine samples donated by the study participants will provide one measure of mercury exposure. Individual speciality and practice history will help establish the risk of exposure. Dental practice history can be determined by use of a questionnaire asking for this information. Blood and urine specimens can be measured for mercury content and provide some indication of the level of exposure over the preceeding three to six months. The concentration of mercury in the blood and urine when combined with a history of exposure provides an indication of actual tissue mercury



## METHODS

This study will be of an analytic case-comparison design. Strength of association between mercury exposure and development of neuropsychiatric disorders in dentists will be measured. All subjects will take the SCL-90 a self reported symptom inventory. In addition, tissue mercury burdens will be determined in all study subjects.

### Data Collection

The sampling frame for this project is all active duty Air Force dentists willing to participate. The USAF Dental Corps is composed of approximately 1000 dentists. The affected group will be composed of dentists with either depression, erethism or xenophobia as determined by SCL-90 test scores. The comparison group will be composed of all remaining dentists. Data on age, duration of pratice, speciality, sex, race and marital status will be obtained to provide an indication of similarity between the groups (table 1). These demographic data will be obtained by use of a questionnaire given to all study participants. The validity of this questionnaire will be pretested by administering the examination to twenty five dentists and comparing their responses with their military records.

The independent variable in this study is exposure to mercury. This variable is difficult to quantify exactly.

by dentists is associated with a higher prevalence of neuropsychiatric disorder. Therefore, dentists with high tissue mercury levels will have a greater prevalence of neuropsychiatric disorders than dentists with low mercury levels.

excellent guide is provided in an article by Johnson and in a dental textbook by Goldman et al. (Johnson, 1978) (Goldman, 1984). Even with the availability of these guides and the effectiveness of the procedures, studies indicate significant numbers of dentists have high tissue burdens of mercury and demonstrate adverse health effects. The reason for this may be the somewhat inconsistent attitude taken by the American Dental Association (ADA). In March of 1983, immediately following the release of the Shapiro study on health effects of mercury exposure, the President of the ADA, Dr. Press, stated the subject had been studied before, and then as now, no significant findings had developed (Anderson, 1983). Further more, Dr. Press stated that the mercury hygiene practices of those dentists studied were no longer current practices. He concluded by stating that the symptoms presented were most likely, related to the manual aspect of dentistry and not to mercury. Overall the comments of Dr Press attempted to negate the study conducted by Shapiro despite other supporting studies and the current nature of the research.

#### Research Goal

The goal of this study is to measure the strength of association between chronic mercury exposure and the development of neuropsychiatric disorders. The hypothesis of this study is that long term low dose exposure to mercury

measurements of the mercury content of hair samples. While these measurements provided indications of tissue mercury burdens, they could not control for a variety of individual characteristics. The only accurate measure of tissue burdens of mercury can be done on cadavers. The authors proposed an x-ray florescence technique which permits a more accurate measurement of mercury concentrations in tissues and organs near the body's surface. This technique was considered less reliable in determining mercury tissue burdens in deeper organs. Overall, this technique is accurate and non-invasive, but expensive and only possible at limited localities. Urine and blood mercury level determinations provide an indication of exposure and can be equated to tissue burden levels.

Any use of psychological examinations is fraught with doubt as to their validity and applicability to the study population. The SCL-90 used by Dr Shapiro in his health related study appears to be an accurate measurement of psychological distress in dentists. A study conducted by Derogatis et al. indicates the SCL-90 correlates closely with the MMPI in eight out of nine primary symptom dimensions (Derogatis, 1976). Lack of correlation in the ninth dimension occurs because the two dimensions measure different symptoms.

Guidelines and procedures for decreasing and even eliminating mercury exposure are readily available. An

Supplies: Stationery, postage, computer supplies (paper and printer ribbons), reproduction support and office supplies ( for example stapler, paper clips etc.). All other supplies will be needed for the duration of the study.

Travel: No travel required.

## DISCUSSION

The purpose of this study is to measure the strength of association between mercury exposure and the development of neuropsychiatric disorders. While it is not possible, a priori, to determine the outcome of the study with any attempt at accuracy previous studies permit some broad conclusions. The Camerino study established the relationship between mercury exposure and behavior (Camerino, 1981). The fact this study used industrial workers as the target population does not prohibit generalization of the findings to other occupationally exposed groups. The most definitive study cited was the one conducted by Shapiro (Shapiro, 1981). One of the areas looked at in this study was whether mercury tissue burdens had an effect on the neuropsychological status of dentists. Both of these studies found individuals exposed occupationally to safe levels of mercury still demonstrated evidence of neuropsychological impairment. Unfortunately, these studies only imply an association, they do not provide odds ratios or relative risks.

Based on the two studies cited, one would expect this proposed study to discover the same thing. This study will determine the actual strength of association between exposure and the development of neuropsychological impairment. With the absence of exposure to mercury one

would expect to find in dentists the same background prevalence of neuropsychiatric disorders found in the general population. The fact dentists have a higher prevalence of neuropsychiatric disorders than the general population implies they are in some way different (Goldman, 1984). Exactly what the difference is has been speculated but never really studied. The general consensus, and one supported by the ADA, is that the nature of the work, necessary and important but painful and unappreciated by the patient, is responsible for a variety of ills among dentists including a greater amount of psychological disorders (Anderson, 1983).

This study is expected to discover a strong association between mercury exposure and the development of neuropsychiatric disorders. Table 2 is expected to demonstrate a trend of decreasing prevalence of disorder proportional to decreasing tissue mercury levels among the dentists studied. Those dentists who have mercury levels equal to or greater than 0.2 mg per gram of tissue are expected to have the greater amount of impairment followed by the exposed group but with tissue burden levels below 0.2 mg but greater than or equal to 0.05 mg per gram of tissue. Finally, the group of dentists with tissue mercury levels below 0.05 mg per gram of tissue is expected to have an impairment rate similar to that found in the general population.

One potential problem with this study is the question of selection bias. If this bias is not controlled for it may slant the conclusions. The study population is all active duty Air Force dentists. All dentists are expected to take part but participation is strictly voluntary. As can be seen in the budgeting section, follow up on those persons who do not participate will be made. Some effort to determine why persons chose not to participate will be attempted. With command support and the confidential nature of all responses the number of persons not choosing to respond is expected to be less than twenty percent (this is based on information supplied by the AFMPC as the expected response to any questionnaire sent to Air Force personnel). Any attempt to generalize the findings of this study to the entire dental profession is expected to generate significant opposition. This study is designed to study active duty dentists only. Conclusions drawn are valid only for this group. The fact that Air Force regulations are stricter than community standards regarding mercury exposure implies that the level of mercury exposure is lower among Air Force dentists than non active duty dentists. In addition, all persons entering active duty are screened for psychiatric history and are generally barred from active duty if they have a positive psychiatric history. These statements alone would imply that the results of this study would tend to be very conservative in regards to the civilian community.



It is recognized that there are other potential causes of neuropsychiatric disorders other than mercury exposure not looked for in this study. A review of the literature has failed to establish any greater overall exposure to these potential causes than that experienced by the general population. Without a study documenting the presence of some other causative factor, other than mercury exposure, the strength of association established in this study should be valid.

## RECOMMENDATIONS

Based on the expected outcome of this study a greater emphasis on mercury hygiene is required. The fact all Air Force dental clinics are required to follow strict safety guidelines in regards to mercury exposure is an asset. Unfortunately Air Force guidelines are based on exposure limits that may be set too high. Also these guidelines are based on average exposure values determined over a period of several hours. They fail to take into account the nature of dental restoration work and the potential of very localized high concentration of mercury in the vicinity of the dentist's face. An easy remedy for this problem is to require all dentists to wear masks designed to filter out mercury vapor. These masks are readily available and are effective in decreasing exposure (Thorne, 1978). In addition, all dental surgeries where amalgam restorations are performed should have solid, non porous smooth floors with the flooring material extended up the side of the wall for four inches. This last step decreases mercury pooling in cracks in the floor and prevents carpeting and other porous floor coverings from collection mercury.

All dentists should be required to attend semi-annual training in mercury hygiene and the hazards associated with mercury exposure. In addition research into alternatives to

mercury amalgams and current restoration practices needs to be done.

The question of other health effects of chronic mercury exposure has been raised. Many other effects have been documented but no strength of association has been stated (Goldman, 1984)(Camerino, 1981). Research to determine the strength of association is necessary. This research will provide the necessary legitimacy to requests for research into treatment of these conditions. It is never really acceptable to treat the symptoms and leave the underlying cause untreated.

APPENDIX A

NAME\_\_\_\_\_

.....perforation.....

NUMBER ON ALL FORMS\_\_\_\_\_

PRIMARY AFSC\_\_\_\_\_

SECONDARY AFSCS\_\_\_\_\_

AGE\_\_\_\_\_

SEX male/female

CURRENT SPECIALITY\_\_\_\_\_

DATE OF GRADUATION FROM DENTAL SCHOOL\_\_\_\_\_

MARITAL STATUS married/single/divorced

TAFSD\_\_\_\_\_

DO YOU HAVE A HISTORY OF MENTAL DEPRESSION? Yes/No

HAVE YOU EVER BEEN TREATED FOR ANY MENTAL ILLNESS? Yes/No

HAVE YOU EVER BEEN TREATED FOR MERCURY POISONING? Yes/No

AVERAGE NUMBER OR AMALGAM RESTORATIONS PERFORMED PER DAY\_\_\_\_\_

AVERAGE NUMBER OF AMALGAM RESTORATIONS REMOVED PER DAY\_\_\_\_\_

DO YOU SMOKE? Yes/No

\_\_\_\_\_ FOR RESEARCHER USE ONLY

MERCURY LEVELS

BLOOD\_\_\_\_\_

URINE\_\_\_\_\_

MEAN\_\_\_\_\_

## APPENDIX B

### PRIVACY ACT STATEMENT

#### PRINCIPAL PURPOSES FOR WHICH INFORMATION IS INTENDED TO BE USED:

The personal information will be used for a study on the effects of mercury exposure on health. All information provided will be computer coded and reported only as group values and trends. Your name is requested on the questionnaire form only as a means of identifying respondents and non-respondents. Names will be removed from all forms upon receipt.

#### ROUTINE USES:

There will be no routine uses of this material.

#### WHETHER DISCLOSURE IS MANDATORY OR VOLUNTARY AND EFFECT ON INDIVIDUAL OF NOT PROVIDING INFORMATION:

The request of information is strictly voluntary. Individuals choosing not to participate will not be identified. All information provided will be kept in strict confidence.

#### STUDY RESULTS:

Study results will be reported as group values. These results will be made available to all study participants who request them. It will not be possible to report individual responses or test results

APPENDIX C

REPLY TO

ATTEN OF: Capt James Cassell (AFIT/CIMI)

SUBJECT: Study on the Hazards of Mercury exposure

TO: ALL DIRECTORS OF BASE MEDICAL SERVICES

1. The Department of the Air Force is supporting a study of the hazards of mercury exposure among dentists. This study is designed to determine the long term effects of mercury exposure.
2. Participation by the individual dentist is strictly voluntary. Participation in this study is not expected to require more than two hours for each dentist. This study will require only routine laboratory support by your facility.
3. All information obtained in this study will be held in strict confidence. Individual participant's responses will be coded and all identifying information removed and destroyed. The data will be presented as group trends.
4. Your support of this study is greatly appreciated and will be of great help in the success of this study.

[Signature block of Air Force SG]

APPENDIX D

REPLY TO

ATTEN OF: Capt. James Cassell (AFIT/CIMI)

SUBJECT: Study of the Hazards of Mercury Exposure

TO: All Active Duty Dentists

1. The Department of the Air Force is sponsoring a study on the long term effects of exposure to low doses of mercury. Present regulations pertaining to mercury exposure limit exposure to levels well within the current accepted range. Current practices in all Air Force dental clinics maintain mercury levels far below the maximum permitted by regulation. Despite excellent mercury hygiene a certain amount of mercury exposure occurs.

2. Participation in this study is strictly voluntary. All active duty Air Force dentists will have a chance to participate. If you choose to participate all information will be kept in strict confidence. Names will be removed from the questionnaire and test sheets prior to coding and analysis. Data will be reported only as group trends.

3. Your commander has been informed as to the nature of the study and the voluntary nature of participation. He has further been informed that all information obtained in the study is confidential and individual information cannot be made available to anyone. Your commander will not be informed of your willingness or refusal to participate in this study.

4. If you choose not to participate please return the entire packet of material in the inclosed envelope.

5. This study will attempt to determine any long term effect of routine occupational exposure to mercury. Without sufficient participation the conclusion of the study become meaningless. This is an important question and your participation is essential if it is to be answered.

[SIGNATURE BLOCK OF  
THE AF SURGEON GENERAL]

## REFERENCES

- Albers, J.W., Cavender, G.D., Levine, S.P., and Langolf, G.D. Asymptomatic Sensorimotor Polyneuropathy in Workers Exposed to Elemental Mercury. Neurology, 1982, 32, 1168-1174.
- Anderson, P.E., Study Shows Long-Term Mercury Exposure Harmful To Dentists, Not Patients, Dental Economics, 1983, May, 65-68.
- Bleecker, M.L., Clinical Neurotoxicology: Detection of Neurobehavioral and Neurological Impairments Occurring in the Workplace and the Environment, Archives of Environmental Health, 1984, 39, 213-218.
- Brown, B.W. and Hollander, M., Statistics A Biomedical Introduction, John Wiley and Sons, 1977, New York.
- Buchwald, H., Exposure of Dental Workers to Mercury, American Industrial Hygiene Association Journal, 1972, 7, 492-502.
- Camerino, D., Cassitto, M.G., Desideri, E. and Angotzi, G. Behavior of some Psychological Parameters in a Population of a Hg Extraction Plant, Clinical Toxicology, 1981, 18(11), 1299-1309.
- Chandler, H.H., Rupp, N.W. and Paffenbarger, G.C. Poor Mercury Hygiene from Ultrasonic Amalgam Condensation. JADA, 1971, 82, 553-557.
- Cheraskin, E. and Ringsdorf, W.M., The Mental Illness Proneness Profile, Alabama Journal of Medical Science, 1973, 10(1), 32-45.
- Conradi, S., Ronnevi, L. and Norris, F.H., Human Motor Neuron Diseases, Raven Press, 1982, New York, 201-229.
- Cross, J.D., Dale, I.M., Goolvard, L., Lenihan, J.M.A. and Smith, H., Methyl Mercury in Blood of Dentists, Lancet, 1978, 5 Aug., 312-313.
- De Freitas, J.F., Mercury in the Dental Work-place: An Assessment of the Health Hazard and Safeguards, Australian Dental Journal, 1981, 26(3), 156-160.
- Derogatis, L.R., Rickels, K. and Rock, A.F., The SCL-90 and the MMPI: A Step in the Validation of a New Self-Report Scale, British Journal of Psychiatry, 1976, 128, 280-289.



Fawer, R.F., De Ribaupierre, Y., Guillemin, M.P., Berode, M. and Lob, M. Measurement of Hand Tremor Induced by Industrial Exposure to Metallic Mercury. British Journal of Industrial Medicine, 1983, 40, 204-208.

Fein, G.G., Schwartz, P.M., Jacobson, S.W. and Jacobson, J.L., Environmental Toxins and Behavior Development, American Psychologist, 1983, Nov., 1188-1197.

Feldman, R.G. Neurological Manifestations of Mercury Intoxication, Occupational Neurology, 1982, 66, 201-209.

Gosselin, R. E., Smith, R.P., Hodge, H. C. and Braddock, J.E., Clinical Toxicology of Commercial Products, 5th edition, Baltimore, 1984, III 271.

Gronka, P.A., Bobkoskie, R.L., Tomchick, G.J., Bach, F. and Rakow, A.B., Mercury Vapor Exposure in Dental Offices, JADA, 1970, 81, 923-925.

Goldman, H.S., Hartman, K.S. and Messite, J., Occupational Hazards in Dentistry, Year Book Medical Publishers, Inc, Chicago, 1984, 71-78.

Goldwater, Leonard John. Mercury; a History of Quicksilver. Baltimore: York Press, 1972.

Hanninen, H. Behavioral Effects of Occupational Exposure to Mercury and Lead, Occupational Neurology, 1982, 66, 167-175.

Harris, D., Nicols, J.J., Stark, R. and Hill, K., The Dental Working Environment and the Risk of Mercury Exposure, JADA, 1978, 97, 811-815.

Johnson, K.F., Mercury Hygiene, Dental Clinics of North America, 1978, 22(3), 477-489.

Joselow, M.M., Goldwater, L.J., Alvarez, A., and Herndon, J. Absorption and Excretion of Mercury in Man, Archives of Environmental Health, 1968, 17, 39-43.

National Research Council, Environmental Studies Board, Panel on Mercury. An Assessment of Mercury in the Environment. Washington D.C.: National Academy of Sciences, 1978.

Pritchard, J.G., McMullin, J.F. and Sikondari, A.H., The prevalence of High Levels of Mercury in Dentists' Hair, British Dental Journal, 1982, 2 Nov., 333-336.

Roberts, R.E. and Vernon, S.W., Depression in the Community, Archives of General Psychiatry, 1982, 39, 1407-1409.

Ross, W.D. and Sholiton, M.C. Specificity of Psychiatric Manifestations in Relation to Neurotoxic Chemicals, Acta Psychiatric Journal of Scandinavia, 1983, 67 (suppl 303), 100-104.

Schlesselman, J.J., Size Requirements in Cohort Case-Control Studies of Disease, American Journal of Epidemiology, 1974, 99, vol. 6.

Schneider, M., An Environmental Study of Mercury Contamination in Dental Offices, JADA, 1974, 89, 1092-1098.

Shapiro, I.M. and Bloch, P., An X-ray Fluorescence Technique to Measure the Mercury Burden of Dentists in vivo, Medical Physics, 1981, 8(3), 308-311.

Shapiro, I.M., Sumner, A.J., Spitz, L.K., Cornblath, D.R., Uzzell, B., Ship, I.I. and Bloch, P., Neurophysiological and Neuropsychological Function in Mercury-Exposed Dentists, Lancet, 1982, May 22, 1147-1150.

Thorne, D.S., Mask Effectiveness in Reducing Mercury Contamination, Quintessence International, 1978, 2, 89-91.

Tsubaki, Tadao and Irukayama, Katsuro. Minamata Disease. Toyoko: Kodansha Ltd., 1977.

Weiss, B., Behavioral Toxicology and Environmental Health Science, American Psychologist, 1983, Nov., 1174-1187.

World Health Organization (Task Group on Environmental Health Criteria for Mercury). Environmental Health Criteria 1- Mercury. Geneva: World Health Organization, 1976.

## AFIT RESEARCH ASSESSMENT

The purpose of this questionnaire is to ascertain the value and/or contribution of research accomplished by students or faculty of the Air Force Institute of Technology (AU). It would be greatly appreciated if you would complete the following questionnaire and return it to:

AFIT/NR  
Wright-Patterson AFB OH 45433

RESEARCH TITLE: Neuropsychological Effects Of Long Term Low Dose Mercury  
Exposure In Dentists

AUTHOR: James Charles Cassell, Jr.

## RESEARCH ASSESSMENT QUESTIONS:

1. Did this research contribute to a current Air Force project?

☐ a. YES

☐ b. NO

2. Do you believe this research topic is significant enough that it would have been researched (or contracted) by your organization or another agency if AFIT had not?

☐ a. YES

☐ b. NO

3. The benefits of AFIT research can often be expressed by the equivalent value that your agency achieved/received by virtue of AFIT performing the research. Can you estimate what this research would have cost if it had been accomplished under contract or if it had been done in-house in terms of manpower and/or dollars?

☐ a. MAN-YEARS \_\_\_\_\_

☐ b. \$ \_\_\_\_\_

4. Often it is not possible to attach equivalent dollar values to research, although the results of the research may, in fact, be important. Whether or not you were able to establish an equivalent value for this research (3. above), what is your estimate of its significance?

☐ a. HIGHLY  
SIGNIFICANT

☐ b. SIGNIFICANT

☐ c. SLIGHTLY  
SIGNIFICANT

☐ d. OF NO  
SIGNIFICANCE

5. AFIT welcomes any further comments you may have on the above questions, or any additional details concerning the current application, future potential, or other value of this research. Please use the bottom part of this questionnaire for your statement(s).

NAME \_\_\_\_\_

GRADE \_\_\_\_\_

POSITION \_\_\_\_\_

ORGANIZATION \_\_\_\_\_

LOCATION \_\_\_\_\_

STATEMENT(s):

**END**

**FILMED**

**10-85**

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